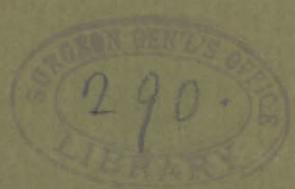


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CEREBRAL LOCALIZATION
IN RELATION TO
INSANITY.

—
CARNOCHAN.



CEREBRAL LOCALIZATION

IN RELATION ~~TO~~

INSANITY,

WITH CASES.

[Read before the Medico-Legal Society, May 14, 1884.]

BY

—
J. M. CARNOCHAN, M.D.,

SURGEON-IN-CHIEF TO THE STATE IMMIGRANTS' HOSPITAL, 1850 TO 1873, 1880 TO 1883—
PROFESSOR OF SURGERY—FORMERLY HEALTH OFFICER OF THE PORT
OF NEW YORK AND ONE OF THE COMMISSIONERS OF THE
HEALTH DEPARTMENT OF THE CITY OF NEW
YORK—MEMBER OF THE MEDICO-LEGAL
SOCIETY OF NEW YORK,
ETC., ETC.



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PREFATORY NOTE.

With the great and rapid increasing immigration into the United States from 1840 to 1847, it became necessary to take some action in order to provide for the care and relief of immigrants who might most require aid and protection, and to adopt some measures from motives of State economy. The number of immigrants suffering from disease and accident increased beyond the proportion of the increase of immigration. To remedy the evils, urgent at the time, the Legislature of the State of New York appointed a Permanent Commission for the Relief and Protection of Aliens arriving at the Port of New York, the expense to be defrayed by a small commutation payment, from each immigrant. Under the auspices of this Commission, the Honorable Julian C. Verplanck acting as President, the foundation of the large Hospital and Refuge establishment was laid for the benefit of the immigrant, on a healthy island contiguous to 110th street, in the 12th Ward of the city. Soon after the construction of these Institutions, without change of residence, I was placed at the head of the Surgical Department, with continuous service, and a sufficient number of competent assistants. The Hospital consisted of Departments embracing General and Special Surgery, Medicine and Obstetrics. To these was added a Department for Lunatics, on account of the increase of insanity among the immigrant population, scattered through different parts of the country.

Acting in concert with the Resident Physician-in-Chief, the late Dr. George Ford, there being no special Alienist attached to the Institution, I had ample means afforded for observing and studying the characteristics and abnormal conditions of the insane. From the opportunities thus presented, and from observations derived from cases necessarily occurring in the current of private practice, I became satisfied that insanity is a morbid condition of the mind, resulting directly or indirectly from disease of a part or of the whole of the Brain, or from imperfect development, and that it is not a disease of the mind, *per se*, independent of functional or structural change.

This view of the pathological source of Insanity bears directly upon the Medico-Legal aspect of the subject, and at the suggestion of the Society, I have, amidst a press of professional business, drawn up the following paper.

14 EAST 16TH STREET,
JUNE, 1884.

"What should fairly and honestly be weighed is, that mental organization is the last, the highest, the consummate evolution of nature, and that, therefore, it must be the last, the most complex, and most difficult object of human study."—*Physiology of Mind*.—MAUDSLEY.

CEREBRAL LOCALIZATION IN RELATION TO INSANITY.*

By J. M. CARNOCHAN, M.D., &c.

THE Localization of Cerebral disease has, of late years, engaged a large share of the attention and labors of medical scientists. Germany, France and England, during the last decade, have gained celebrity by the physiological and pathological investigations and the knowledge contributed, by some of their distinguished men, in this department of neuro-pathic research. The term Cerebral Localization is derived from the fact now generally accepted that the brain, or the large nervous mass occupying the cranial cavity, is not a single organ performing a single function, but that it is composed of an aggregation of many organs or cerebral centres, each possessing special functions, acting separately at times, but at others, functioning in concert by a pre-established harmony of action, by means of which the numerous complex phenomena of mental manifestations are produced.

A knowledge of the principles and facts underlying the doctrine of cerebral localization has become a necessary introduction to the study and comprehension of insanity.

The subject of insanity is one of great interest in a medico-legal point of view, not only on account of the frequency with which this condition is brought before the courts of

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law for adjudication in reference to the possession and management of property, but also in cases of criminal jurisprudence where grades of punishment are being balanced in the scale of justice, and the life of the individual is often-times at stake. There is, also, the philosophical and physiological view of the subject in regard to its nature, etiology and the various phases which it assumes, and this may be called the *medical aspect*. The fact that opinions regarding the nature of insanity differ so widely, implies that the study of its characteristics is one of difficulty. In this respect insanity resembles some other morbid conditions of the organism, such as catalepsy, epilepsy, hydrophobia and other abnormal states of the nervous system that, as yet, are not clearly comprehended. The localization of the different functions of the brain, with the view of removing the obscurity connected with the etiology and pathology of cerebral diseases in general, has within the past few years received more attention and careful study than at any previous time, and a new and more enlarged field has been opened up in this department of scientific knowledge. Emanating from these researches, more exact opinions regarding the nature of insanity are being entertained that are likely to remove the confusion and complexity which, heretofore, have been prevalent in discussions and opinions concerning the various phases of mental aberration.

It is customary in the ordinary curriculum of medical studies to give attention to the healthy structure of the human body, in order to acquire the knowledge necessary to understand its diseases or morbid conditions. So, in the study of diseases of the brain, of which insanity is one, it becomes necessary to be conversant with the minute structure and

physiology of the brain and the other parts of the nervous system. I shall endeavor to follow this rule and take a hurried glance at the different views entertained regarding the healthy action of the mind before reaching the main subject of this paper—that of insanity.

In looking into the history of mental philosophy and retracing it for centuries back, even to the epoch when philosophy, such as it was when it first assumed a name, it becomes a matter of surprise to the student of the present day to observe how indefinite and vague were the notions entertained by the ancient philosophers concerning the nature and action of the healthy mind—the *mens sana*. With such erroneous and intangible theories and vague and unintelligible hypotheses as are found in their writings, it might be asked how could it be possible to arrive at correct opinions and conclusions when discussing, or writing on the complexities of the diseased mind—or insanity, *the mens non compos*.

The history of the early centuries of the world affords only indefinite information regarding the study of mental phenomena. Some individuals were considered more wise than others, and were often supposed to be endowed with supernatural gifts. Possessing acute and enlarged powers of observation, and from a close study of human character, they gained control over their compeers, became chiefs, great warriors, teachers, or astute law-makers for their time, and formed systems and rules of conduct for the guidance of their own actions and those of their followers. Solon and Thales and the remaining five of the seven wise men, mentioned as living before the ante-Christian era, 494 B.C., were called *Σοφισται* (teachers of wisdom), to denote their practical sagacity rather

than their knowledge of philosophy as such. Herodotus is considered as the oldest writer (445 B.C.) known to have introduced the term philosophy, as denoting a system the object of which was the acquisition of true knowledge, and which would reach facts in the concatenation of cause and effect. Prior to the time of Herodotus, however, the scholars of the day, groping amidst the complexities of mental speculations, felt the necessity of drawing distinctions between the different functions and manifestations of the mind, and hence originated the numerous sects that received denominations according to the name of their authors, or to the hypotheses identified with the peculiar doctrines promulgated. Among this class of reasoners may be enumerated the Electics, the Dialectics, the Ionics, the Atomists, the followers of Pythagoras, of Plato, of Socrates and of Aristotle.

The founders of these and other ancient schools of philosophy became famous by the promulgation of theories of mental action mixed up with speculation concerning ethics, religion, the pursuit of happiness, justice, moral culture, cosmology, metempsycosis etc. The *Ionic* school may serve as a type of the methods and train of thought that agitated the minds of the ante-Christian philosophers. One of the problems of the Ionics was the attempt to generalize the universe, and to resolve all nature into some great unity or common substance or principle. Thales considered water the primordial and fundamental principle. Anaximander adopted as the foundation of the universe something called by him the *Infinite* or *Indeterminate*, out of which the various definite substances, air, fire, water etc., were generated, and to which they were again resolved. Anaximenes assumed

air as the primordial substance which by rarification produced fire and ether, and, by condensation, water, air and stone. Pythagoras gave the harmony of numbers as the essence and foundation of all existing things, the different numbers being representative of different natural properties and powers. The *Atomic* theory was represented by Democritus 430 B.C., who attempted the solution of the grand problem of external perception, regarded as a leading question, by the application of the Atomic hypothesis. He supposed that all things were constantly throwing off images of themselves, which enter the soul through the pores of the organs of sense.

Socrates, 435 B.C., repudiated the speculative doctrines of the philosophers who had gone before him as to the origin of all things out of water, fire, air, etc., and led the way to a more precise method of thought by considering evidence as the basis of reasoning, and teaching that all human things should be learned by diligence in study and investigation. The *Platonic philosophy* differed from the Socratic, in as much as the doctrines of Socrates were founded on the necessity of external evidence in reasoning, while the platonic school is based upon idealism, as opposed to realism, materialism, or sensationalism, the capacity of forming and using ideas being taken as an essential quality of the mind as contrasted with the external forms by which these forces are manifested. Aristotle, 384, B.C., the pupil of Plato, taught a philosophy differing from that of Plato in many points, especially in the fundamental doctrine termed the theory of ideas. The entire method of Aristotle was in marked contrast to the platonic system of viewing philosophical subjects. Aristotle was a close observer and col-

lector of facts, from which he drew inductions. He promoted the development of syllogistic reasoning, and introduced a system of formal logic which became insensibly infused into the minds of succeeding scientists, and has contributed much to form what is correct in the methods of modern metaphysicians.

The *Epicurean* sect and that of the *Stoics* formed in part upon the Aristotelian doctrines, transmitted their philosophy and characteristic mental speculations from the Socratic epoch into the commencement of the Christian era. Thus for over three thousand years, preceding the time that philosophical theories taught by Confucius and his contemporaries in the East became known in the West, the history of philosophy informs us that the different doctrines and mental speculations were mainly made up of controversial theories and hypotheses concerning the operations of the mind based upon no more solid foundation than the metaphysical vagaries and propositions of the acknowledged leaders and champions of the popular and prevailing sects of the period in which they flourished. In the early centuries, after the introduction of Christianity and the Roman Conquest, Alexandria, from its geographical position, became the focus at which the philosophers of the East and West congregated and interchanged their various dogmas and theories regarding theology, literature, politics, psychology and other metaphysical topics of the day. At this time the school of *Neo-Platonism*, founded on the doctrines of Plato, took its origin and became the representative centre of the speculative notions that grew up in the Alexandrian school, from the "fusion of Greek philosophy, Oriental mysticism and the Jewish and Christian controversies on religion."

The school of *Gnosticism*, composed of men of knowledge, as the name implies, arose in the Second century. Its speculations on the mind were mainly based upon the doctrines of Plato, and one of its principal efforts and studies was directed towards creating a philosophy upon a Christian foundation. Great theologians and metaphysicians belonged to this school. The Ecumenical Councils, famous in ecclesiastical history, held at Nice, a city of Bythnia, in Asia Minor, in 325, and 787, were made up of scholars of this class, among whom may be mentioned Athanasius, Gregory of Nysa and St Augustine, who were noted for their physiological labors and mental disquisitions.

In the ninth century the *Scholastics* appeared, and early in their history became remarkable for their controversies on *nominalism* and *realism*, and later by the revival of the school of Aristotle and the refutation of the doctrines of Pantheism. The names of Alexander, of Bonaventura, Albertus Magnus, Duns Scotus and Thomas Aquinas, were conspicuous at that period, among the great theologians and teachers of this school. From this time forward, during the following centuries, until the time of Roger Bacon, 1214-1294, numerous teachers and schools sprang into activity, more especially in the Western region of civilization, chiefly occupied with theories on nominalism, realism, idealism, immortality of the soul and other subjects appertaining to the domain of metaphysical enquiry, and then receded, after having exercised, for a time, their period of authority. The Platonic and Aristotelian doctrines which, for many centuries, had formed the basis of the different sects of philosophers, had prepared the way for a closer system of ratiocination. During the 16th century and early part of the 17th, (1561-1626,) a new

class of philosophers appeared who abandoned the traditional servitude of authority dictated by their predecessors, and adopted new methods in the analyses of mental phenomena. About this epoch the names of Francis Bacon and René Descartes became conspicuous in the philosophical world—1561-1596.

Between the sixteenth and eighteenth centuries (that is between the time that Francis Bacon enlightened the philosophical world by his writings and John Wilson, the famous Christopher North, who occupied the chair of mental and moral philosophy in the University of Edinburgh, 1830), many remarkable men lived and left the imprint of their powerful minds on the age in which they figured, by their philosophical essays and more elaborate works. Francis Bacon, Descartes, Thomas Hobbes, Locke, Malabranche, D'Alembert, Leibnitz, Bishop Berkeley, Hume, Kant, Condillac, Condorcet, Thomas Reid, Dugald Stewart, Thomas Brown, John Wilson and Sir William Hamilton may be named as among the most brilliant of the minds that shed lustre on the civilized world, during this epoch. Each of these philosophers discussed with earnestness and ability subjects embracing the general domain of mental philosophy, morals, theology, politics, the various processes of mental action and physics, each adopting peculiar methods of *ratio*cination and of mental analyses, and often guided by antecedent education and early surroundings.

Bacon is generally accredited with leading the way to more correct methods of analytic enquiry by the introduction of the *inductive method*. This system undoubtedly formed the basis of a more accurate and precise school of reasoning, for, in regard to whatever supposition or theory

of mental action might be started and advocated, the inductive method was generally adopted, in order to prove and substantiate its correctness.

Descartes, as one of the early reformers, professed to admit nothing as true that was not confirmed by reason and experiment. He found, as he supposed, no ground for certitude in any of the various departments of knowledge except one, and only one proposition that seemed to him to stand the test of truth, and of which the truth could not be doubted. That proposition was that *he existed*, which he inferred from the fact of his possessing consciousness. He could not doubt that *he* felt and thought, and, therefore, he did not doubt that *he*, the feeler and thinker, *existed*. This relation between consciousness and existence he expressed by the words "*Cogito, ergo sum*"—"I think, therefore, I exist." Such was one of the dogmas of Descartes.

The philosophical system of Hobbes, who was contemporaneous with Bacon and Descartes, was of the materialistic type. He held sensation to be the basis of all knowledge, thought to be a process of adding and subtracting representations produced by physical impressions, and introduced a twofold method of scientific investigation by *induction* or *analysis* and *deduction* or *synthesis*.

The essay on the "Human Understanding," by Locke, appeared in 1690, and was regarded as the great authority by the sensualistic philosophers of the eighteenth century. His system tries to show that there are no "*innate ideas*," that the mind is a *tabula rasa*, ideas being used for whatever is in the mind. His main postulates are laid down by himself as follows:—"Let us suppose the mind to be, as we say, white paper, void of all characters, without any ideas, how comes

it to be furnished? Whence has it all the materials of reason and knowledge? To this I answer in one word, from experience. In that, all knowledge is founded, and from that it ultimately derives itself." * * * * And, again, "Our observation employed either about external sensible objects, or about the internal operations of our own minds, perceived and reflected on by ourselves, is that which supplies our understanding with all the materials of thinking. These two are the fountains of knowledge from whence all the ideas we have, or can naturally have, do spring. These are called *sensation* and *reflection*, and it is important to observe that the latter must wait on the former."

Such, in brief, may be said to comprise the principal dogmas of one of the greatest philosophers of the last century.

It is somewhat remarkable that the postulates of Locke somewhat coincide with the theories of Gall, who based his doctrines upon the localization of certain faculties in special parts of the brain, while Locke reached his conclusions through introspective and abstract ratiocination. Bishop Berkeley followed soon after Locke, and published among other writings his "Treatise Concerning the Principles of Human Knowledge," in which he proposed a scheme of absolute Idealism. He affirmed that there was no proof of the existence of a material world, and gave the name of "ideas" to the objects of which we are conscious in perception, attributing them to a supernatural agency that causes them to pass in a real and orderly succession before the mind.

In contrast with the school of Berkeley, Hume's philosophy was directed towards naturalism and scepticism. He believed that ideas were copies of impressions of individual

things. He gives an exposition of the basis of his system thus:—"All the perceptions of the human mind resolve themselves into two distinct kinds, which I call *impressions* and *ideas*. The difference between them consists in the degrees of force and liveliness with which they strike upon the mind and make their way into our thought and consciousness. Those perceptions which enter with most force and violence we may name *impressions*, and under this name include all our sensations, passions and emotions as they make their first appearance in the soul. By *ideas* I mean the faint images of these in thinking and reasoning." The opinions of Hume had great currency, and became the stimulating influence of the notable systems of D'Alembert, Marmontel, Diderot, Condorcet, Condillac, Helvetius, Malesherbes and other philosophers of his time.

Kant, 1724, became imbued with the scepticism of Hume in regard to the objective validity of our ideas, especially in relation to the idea of causality. He conceived a system of critical philosophy which, from its metaphysical character, had received the name of *transcendentalism*. The central object of this system seems to be twofold; first, to separate the necessary and universal incogition from the knowledge we derive through the senses; secondly, to determine the limits of cognition. It is difficult to follow the transcendental ratiocination of Kant, and probably the nearest conception we can obtain of his meaning, except by a deep study of his various works, is derived from the definition given of the word *transcendental*; which has been applied to his system—viz, "all philosophy which carries its investigations beyond the sphere of things which fall under our senses is transcendental, and the term is thus synonymous with meta-

physical. Transcendental philosophy may begin with experience, and thence proceed beyond it; or it may start from ideas *a priori* which are in our mind. In the latter case, the philosophy is purely transcendental, while in the former it is of a mixed character."

Leibnitz, 1646-1716, remarkable for his scholarship and the vastness of its range, is perhaps more noted for his doctrines of the action of the mind than for his other great acquirements. The most important hypotheses of his system may be stated to be his doctrine as to the origin of Ideas, his theory of the Monads, of the pre-established Harmony and the theory of Optimism. Ideas are supposed to come from spiritual Monads; the theory of Optimism affirms the doctrine that the universe, being the work of an infinitely perfect Being, is the best that could be created; that everything is ordered eventually for the best, so that everything is good in relation to the whole—all being made to promote the general good.

His celebrated doctrine of pre-established Harmony is that which has claimed most attention. It supposes "the mind and the body to be two distinct and independent machines, each having its own independent though simultaneous action, but both so regulated by a harmony pre-established by God, that their mutual actions shall correspond with each other, and shall occur in exact and infallible unison." This hypothesis has been called by another philosopher "the dream of a great mind."

Thomas Reid, one of the noted Scotch philosophers, published several essays on philosophical subjects: in 1785, his treatise on the Philosophy of the Intellectual Powers; and in 1788, the philosophy of the Active Powers appeared. His

writings attracted much attention, and he became, in his own country, the chief of a school whose aim was to "deliver philosophy from scepticism by resting finally on principles of intuitive or *a priori* origin." Reid was succeeded in Scotland by Dugald Stewart (1775); and Thomas Brown (1809), followed up the controversies begun by Reid against the systems of Berkeley and Hume. Brown was succeeded by John Wilson as professor of moral and mental philosophy in the University of Edinburgh, and he was succeeded by Sir William Hamilton. The two last named teachers were profound scholars, and contributed learned essays and treatises on subjects connected with the study of the mind, ethics and politics, but their names are not associated with any important system in the domain of mental philosophy.

It is seen from the brief *aperçu* just made, that the various philosophical systems heretofore mentioned as controlling the psychological world, since the commencement of the Christian era, have been constructed by the introspective action of the mind itself, acting upon the very subject which it wishes to define and analyze, without any premises to be used as the basis of ratiocination other than the fleeting phases of the mind itself. From the resulting confusion and the variety of conjectural speculations that have arisen, during so many centuries, the conclusion to be most readily drawn is, that there may be, as D'Alembert truly says, "a great deal of *philosophizing* in which there is very little of philosophy."

Since the time of Sir William Hamilton, 1829-36, a school of philosophy has sprung up whose methods of research in the realms of thought are based on the materialistic theory that mental manifestations, of whatever character, are the

essential functions of vital organizations. Of this new class of scientists Herbert Spencer may be mentioned as the most distinguished representative, but long before the publications of this writer were issued, a philosopher had appeared who was intently engaged in the prosecution of the study of the Brain and nervous system, with the main object in view of confirming his theory that the phenomena of mental manifestations were in direct correlation with the structure and development of the cerebro-spinal axis and the nervous appendages connected with it.

Franz Joseph Gall was born in Baden in 1758, and after studying at Baden, Bruchsal and Strasbourg, received the degree of Doctor of Medicine at Vienna, in 1785. He was possessed of unusual powers of observation, and early in life began to observe and compare the craniological formation of man, and to refer the variety of mental peculiarities and of moral characteristics of persons thus examined to the diversified development of the cranium, resting his theory upon the alleged approximate similarity existing between the outline of the cranium and the external configuration of the Brain.

In 1796, he gave lectures on this subject in Vienna, but the new theory met with much opposition, and in 1805 he was interdicted by the government from repeating his lectures in public. Gall, after this, visited Paris, and entered upon the practice of medicine, and at the same time, with his pupil Spurzheim, commenced a series of studies upon the Brain and nervous system that resulted in the completion of several important works, among which may be mentioned *Philosophisch-Medizinische Untersuchungen* (1791), *Recherches*

sur le Système Nerveux (1810-19), and *Sur l'Origine des Qualités Morales et de Facultés Intellectuelles* (1822-25).

Spurzheim, following up the principles of his master, visited Scotland, England, and finally America, giving lectures to inculcate the system of mental philosophy inaugurated by Gall. These two scientists, like most founders of a sect, claimed too much for their theory. Gall, as a part of his system, wished to establish certain empirical doctrines under the term of phrenology, upon the assumption that the relative development of the centres of the brain can be accurately determined by external examination of the cranium, "by protuberance in one part as contrasted with depression in another quarter, and by other indications in their nature, not demonstrable, in any special instance, without post-mortem examination, and yet having a certain degree of foundation in the general truths of physiology." It was this pretension of imposing an untenable dogma upon his general system that led to the rejection of his general theory regarding the functioning powers of the brain. The leading positions of Gall, however, have been verified, and have been absorbed into the scientific psychology of the present epoch under the denomination of psycho-physics in Germany and cerebral psychology in England. Wagner, Huschke, Bain, Carpenter, Ferrier, Spencer, Huxley, Tyndal, Maudsley and Darwin are the leading representatives of this school of philosophy of the present day.

Still the subject of Insanity is clouded by the dogmas of the metaphysical school of philosophy, and is so entangled by ancient theories concerning the normal constitution of the mind and the primeval methods of studying the mind in

health or in disease, that no two authors can be found who give a precisely similar definition of Insanity.

Gall commenced his system of localizing the organs and functions of the brain by apportioning the brain into regions, limiting them, in general, by the dividing furrows or *fissures* of the several lobes. To the convolutions of the frontal lobe, the intellectual and perceptive group of centres were allotted. In the posterior lobe and lower range of the middle lobe, the affective organs and those of the animal propensities were found; while the moral and aesthetic group of centres were located in the upper and coronal parts of the brain. The cerebellum is supposed to have the function of presiding over procreative activity. As concerns these propositions, with the exception of the functions attributed to the cerebellum, recent experiments in vivisection have, in a great measure, verified their accuracy. No one conversant with the modern discoveries in physiology can be in doubt, even in the present condition of medical science, concerning the possibility of localizing many organs of the brain through the activity and instrumentality of which certain special functions are made manifest.

The discoveries of Sir Charles Bell, 1811, corroborated by Magendie and Longet in 1840, have placed the spinal centres of general sensibility and of locomotion in the posterior and anterior columns of the medulla spinalis, and, in tracing the nervous strands of white medullary matter and the gray cineritious substance of this organ upwards into the brain, at different sections, the motor and reflex centres of the functions of respiration, of digestion, of the tongue and the pharynx are definitely located at the medulla oblongata. Also, in connection with the extended continuity

and prolongation of these same strands and ganglionic deposits of gray matter and piercing the brain at the junction of the medulla oblongata with the pons varolii, the nerve of *audition* and the *motor nerve of the face* are seen, the first taking origin at the gray matter of the fourth ventricle, and the second connected at its root, with the motor part of the medulla oblongata. Anterior to these, and still in connection with the advancing strands, the nerve of the external rectus, *the sixth pair*, and the nerve of the other motor muscles of the eye-ball and of the orbit, *the third pair*, are met with—the *sixth pair*, connected with the medulla oblongata, emanating from the substance of the brain in front of the pons varolii; and the trunk of the *third pair* from the side of the crus cerebri, from the deep part of which it takes its origin. The root of the *fourth pair of nerves*, called *pathetici*, from their action in turning the globe of the eye upwards in the expression of prayer, is placed near the surface of the fourth ventricle, at the calamus scriptorius. The *sensory* portion of the *fifth pair* of nerves, the nerve of general sensibility of the face and of the appendages of the organs of special sense, has its real origin localized at the medulla oblongata and in the interior of the pons varolii, and is seen piercing the *pons*, anteriorly upon its external side. The *motor* portion of the *fifth pair* takes its origin in connection with the pyramidal or motor portion of medulla oblongata.

The nervous centres of the organs of *special sense*, of *smell*, of *sight*, and of *hearing*, can also be localized with the same degree of precision and certainty. That of hearing, the *portio mollis* of the seventh pair, has already been located. The *visual centre* is known to be placed in connection with the *tubercula quadrigemina*, and the *corpora geniculata* of the

optic thalamus ; and that of the *olfactive sense* at the posterior part of the anterior lobe, the lower part of the middle lobe, and at other proximal points of origin.

The great basal ganglia—the *tuberula quadrigemina*, the *optic thalami*, and the *corpora striata*, large aggregations of *cineritious* nervous substance, intermingled with white fibres seated inferiorly and in the interior of the brain, are known to be auxiliary to the functions of motion and of general and special sensation, and to serve as the means of elaborating the nervous influence which supplies the organs that are in connection with them.

The evidences and examples thus given of the identification of certain functional manifestations, such as motion and sensation, with defined or limited parts of the medulla spinalis and of the cerebral strands continued from it, and, also, of a similar correlation and identification between the functions of the special senses and the nervous centres on which they are dependent, serve as examples of the reality and utility of the principle of localization, and are as much mental in character as those functions attributed to the more introspective or psychological organs.

The localization of the functions of the cerebral convolutions on the surface of the brain has not been, as yet, so absolutely defined or limited as those referred to in the interior and lower part of the brain. It is generally conceded, however, with whatever other functions they may be classed, that the convolutions placed on the general surface of the cerebrum are the seat of the intellectual or reasoning faculties and of the other mental functions differently manifested, such as the emotions, etc.

Recently a new role has been assigned to the cortex of the

cerebral convolutions to which, previously, the functioning power of the superior mental qualifications alone had been referred. In 1870, two physiologists, M M. Fritsch and Hitzig, remarked that an electric current made to pass along the head from right to left produced movements in certain muscles of the eyes. Experiments were then made upon the brains of dogs and other inferior animals, with results of a similar character. In 1873, Hitzig published a memoir in which he announced that the electric excitation of certain regions on the surface of the brain produced contractions in certain groups of muscles connected with definite movements of the head, body and limbs.

About the same time, this subject was pursued farther by Ferrier of London, who made his experiments upon the brain of the monkey, as being more closely allied in configuration to the human brain. Ferrier localized the motor regions of the cerebral hemispheres, in general terms, in the convolutions about the upper portion of the *Fissure of Rolando*, especially in the ascending frontal and ascending parietal convolutions. Centres of sensation have, also, been assigned to the cortex of certain parts of the brain, but these have not been localized as definitely as those of motion, but, as far as known, are supposed to be localized in the postero-lateral regions of the hemispheres. The experiments and statements of these distinguished physiologists have given an extended impetus to the study of this department of physiology, and have been accepted by many as established facts. On the other hand, active opposition has been made to their assertions, the motor effect of the electric excitation being attributed to the extension of its influence to the medullary fibres passing onward from the

corona radiata to be dovetailed or interlaced among the several layers of the cells and cineritious substance of the cerebral cortex. This argument is not without weight; for example, the optic tracts have their origin in three separate nuclei of gray matter, viz., in the *nates* of the *tubercula quadrigemina*, the *corpus geniculatum externum* and the *optic thalamus*, and, according to Meynert and Huguenin, there are indirect connections between these nuclei and the cortex of the hemispheres, consisting of diverging fibres from the optic thalamus and the corpus geniculatum. These fibres take part in the formation of the *corona radiata*, and pursue their course toward the *gyrus angularis* placed at the posterior part of the hemisphere and considered by Ferrier as a visual centre. Again, in disease or excitation of the Convolution of *Broca*, the same general explanation may be given in regard to the voluntary combination of ideation and of muscular movements necessary for intelligent articulation, the motor centre of which is placed in correlation with the posterior and lower part of the third left frontal convolution, through the influence, direct or reflex, of the fibres of the hypoglossal nerve and its origin at the medulla oblongata—the defect or destruction of which combination produces *aphasia* in its different forms.

There are two kinds of aphasia, the *amnesic* aphasia, where the patient cannot say what he wishes, because he cannot recollect the words or ideas he wants to express, nor can he write them; and the *ataxic* aphasia, where the patient knows the words or ideas he wants, but cannot speak or read aloud or articulate even what he has written.

These conditions are entirely distinct in origin or in causality—the ideal or amnesic aphasia can be referred to the morbid condition of the cortex alone, and the ataxic

aphasia to the abnormal condition of the hypoglossal nerve and the white substance of the Broca convolution. If both substances of the convolution, the cortex and the white medullary substances, are diseased, the aphasia becomes complete, there being neither the ideation of language nor the power of articulating it.

There is probability that the hypoglossal or motor nerve of the tongue, taking origin in the motor apparatus of the bulb, is indirectly in connection with the convolution of Broca through radiating fibres communicating with the bulb.

The theory of localizing motor and sensory centres in the cortex of the hemispheres, even if regarded as established, must be looked upon as an ancillary arrangement. The most important functions belonging to the cerebral hemispheres, as a whole, are directly connected with the exercise of the various psychical or mental manifestations. This correlation of the mutual dependence of function upon organization rests upon such established proofs as to be no longer a subject of argument among physiologists. The results following the partial or total removal of the hemispheres by vivisection made upon the lower animals; of injuries or diseases of the brain; and of imperfect development, as in cases of idiocy, can only be alluded to, at present, as corroborative of the physiological fact that the organs of the mind are located in the encephalon, and are mainly functionalized and manifested through the instrumentality of the hemispherical ganglia of the cortical substance of the cerebral convolutions.

A classification, founded upon this anatomical basis of the normal actions of the mind, is likely to remain and take precedence of other classifications resting upon purely ideal hypotheses.

If the regions of motor centres are confidently asserted to be localized in certain parts of the cortex, just mentioned, the same is not so positively stated in regard to centres of sensibility.

According to Betz, of Kiew, the *postero-lateral regions* of the gray cortex of the convolutions are destined for functions of sensibility. These regions would comprise the convolutions in which the ribbon of Vieq d'Azyr is situated, and particularly, the temporal lobe and the sphenoidal lobe including the *triangular lobe* and the *quadrilateral lobe* placed upon the internal face of the hemisphere. Some authors locate the *sensorium commune*, the common centre of sensation, in these regions, and, according to Charcot, this hypothesis is founded upon anatomical and pathological considerations. Admitting the fact urged by many experimenters that an important influence resides in the gray cortex of the convolutions in certain parts of the brain to which certain motor and sensory functions are attributed, there is sufficient proof that the encephalon is the seat of the various phenomena of intelligence, and that the gray cortex of the cerebral convolutions, regarded as a whole, is composed of a plurality of nervous centres through the functioning powers of which the mental faculties are performed and made manifest. Moreover, the material conditions of the intelligence, of the sentiments and of the instincts, have to be brought into correlation and associated with each other, and this is brought about by the various intercommunicating medullary white fibres of which the remaining substance of the convolutions is made up.

The cortex of the convolutions, in fact, overlaps and encloses four species or kinds of fibres which terminate, most

probably, among the cells of the gray substance and, from the part they perform, are denominated *commissural fibres*; *arciform* or *fibres of association*; *peduncular* and *radiating fibres*. The phenomena of the special senses and of general sensibility and motion are entirely mental in character and are the productions of particular cineritious and medullary centres. It is only carrying the analogy farther, to attribute the intellectual, affective and other faculties to the functional influence evolved from the ganglionic centres of the convolutions with which they are correlated. Wherever placed in the brain, the gray matter and white medullary fibres are in direct or indirect communication, the one supplying the psychic or ideal functionating influence, while the others act as the internuncial heralds and messengers.

As heretofore mentioned, Locke compared the original vacant condition of the mind to a white sheet of paper, (the *tabula rasa*), devoid of characters, but possessing the susceptibility of receiving and retaining perceptions, from impressions derived through the external senses, which perceptions he called *sensations*. This class of perceptions, according to the theory of Gall, are also produced through the external senses and are evolved by the agency of peculiar *stimuli* acting upon the dormant susceptibilities of the cerebral convolutions, and arousing their special functions into activity. The other class of mental action or ideas, following *sensation*, called by Locke *reflection*, and which he supposed to originate, through the action of the mind itself, according to the materialistic doctrine, would be considered as nothing more than the active ideation of the cineritious cells of the same or of another set of convolutions.

The phenomena of the mind are apparently so infinite

that it might seem a hopeless effort to attempt to reduce, under a few heads, the innumerable sensations and feelings which diversify almost every moment of existence. The philosophers of various sects, however, from remote ages, have assumed the task of rendering to psychological science the same kind of generalization which, in physical research, has proved of such utility, by adopting systems of mental classification.

One leading classification which was sanctioned and adopted by metaphysicians for many ages, is the division of mental phenomena into those which belong to the *understanding*, and those which belong to the *will*.

Another division of the phenomena of the mind, somewhat resembling the ancient division of philosophy into the *contemplative* and the *active*, is, into those which belong to the *intellectual* powers and those which belong to the *active* powers. Another classification of mental phenomena, more allied to the views entertained by the metaphysicians of the different systems of philosophy of the present day, is the arrangement of all the mental phenomena into two definite classes, according as the causes or immediate antecedents of our feelings are themselves material or mental. The former of this class—that of the *external affections* of the mind—is so simple as to require but little subdivision. The other class, however, that of the *internal affections*, or states of mind, comprehend so large a proportion of mental phenomena, and are of such a various character, as to require a number of subdivisions.

The first great subdivision of the *internal* class is into our *intellectual states of mind* and our *emotions*, and these appear to exhaust completely the whole *internal* affections of the

mind. We have sensations or perceptions of the objects that affect our bodily organs ; these are termed sensitive or *external affections* of the mind ; we remember objects, we imagine them in new situations, we compare their relations, these mere conceptions or notions of objects and their qualities, as elements of our general knowledge are what are termed the *intellectual states* of the mind ; we are moved with certain lively feelings on the consideration of what we thus perceive, or remember, or imagine, or compare, with feelings, for example, of beauty, or sublimity, or astonishment, or love, or hate, or hope, or fear ; these and various other vivid feelings, analogous to them, are our *emotions*.

There is no portion of our consciousness which does not appear to be included in one or other of these three divisions. This, in brief, is the classification of Brown, and approaches, by purely mental ratiocination, the arrangement adopted by the materialistic philosophers.

In contrast with the classifications of the mental phenomena just mentioned, formed by the mind itself reasoning upon the mind, is the classification of the functions of the mind constructed upon a basis purely organic or material. It rests upon the doctrine that there are two entities only in nature —matter and mind ; the one dependent upon the other, both indestructible, but susceptible of change in their relations. The brain is viewed as the organ of the mind, subdivided into a plurality of organs, which, to simplify description, are arranged in separate regions and localized according to the character and nature of their special functions. By this doctrine, no doubt is allowed to exist in regard to the functions of the brain, as a whole, and, although diversity of opinion may arise as to the precise

assignment of place among the co-operating parts, it is asserted that in the encephalic lobes are localized the *material conditions* of intelligence, the sentiments, and the instincts. The classification, thus founded, arranges all the mental phenomena into the *intellectual* faculties, the *moral* faculties, and the *affective* faculties, including the *animal propensities*.

In order to render more intelligible the dogmas of the *organic* classification, a new nomenclature for certain expressions, such as faculty, power, activity, memory, attention, perception, and conception, has been adopted. To the process of the mind, as manifested through the action of the organs, the term *faculty* is applied. Power, in whatever degree possessed, is capability of feeling, perceiving, or thinking. Activity is simply readiness and quickness. Memory is not regarded as a general *faculty* of the mind, as is customary with the metaphysicians, but is considered an attribute or a mode of action of the faculties. Perception is a susceptibility of an organ put into activity, and not a distinct faculty of mind, so of *conception*, it is but a mode of action of the faculties and not a *faculty*; it is the susceptibility of the faculties started into activity by internal causes. For example, in regard to memory, the painter may have a memory for colors which the sculptor does not possess, the linguist may have a memory for language not understood by the mathematician, and so on with other supposed metaphysical faculties which are not regarded as such, but looked upon as merely susceptibilities of organs put into a state of activity by external or internal causes.

On the external aspect of the Hemispheres, the three principal fissures are seen, the fissure of Rolando, the fissure

of Sylvius and the external perpendicular fissure. The four lobes of the hemispheres are divided by natural fissures and by artificial lines; these lobes contain the convolutions which are limited by numerous anfractuosities coursing in a serpentine manner in various directions, and are much more regular and constant than might be expected from a cursory examination. The same general disposition of furrows and convolutions is found to be present upon the base of the brain and along the internal surface of the hemispheres. The cerebral lobes are named according to their situation, as follows: the Frontal lobe, the Parietal lobe, the Temporo-sphenoidal lobe and the Occipital lobe.

The Frontal lobe is much the largest of the four, and presents, on its external surface, an amount of cortical or gray substance nearly as extensive as that of the other three lobes united. It is divided from the parietal lobe by the fissure of Rolando, and contains within its limits four principal convolutions. The frontal ascending, and the first, second and third frontal convolutions. The para-central convolution is partly placed upon the inner aspect of the lobe.

The Parietal lobe is limited in front by the fissure of Rolando, posteriorly, although imperfectly, by the external perpendicular fissure, inferiorly, by the posterior prolongation of the fissure of Sylvius. Externally, on this lobe, a notable fissure is met with, the inter-parietal fissure; and three convolutions, the ascending parietal convolution, the superior parietal convolution and the inferior parietal convolution. Upon the internal hemispherical aspect, the quadrilateral lobule, the precuneus and a part of the para-central lobule are placed.

The Temporo-sphenoidal lobe is bounded superiorly by the

posterior prolongation of the fissure of Sylvius, anteriorly by the anterior part of the fissure of Sylvius, posteriorly, by an imaginary perpendicular line dropped from the posterior part of the inter-parietal fissure, ending at the basal surface of the brain, inferiorly, by the surface at the base of the brain. This lobe contains a marked fissure called the parallel fissure, and the temporal convolutions designated as the first, second and third.

The Occipital lobe is bounded superiorly, by the external perpendicular fissure, anteriorly, by the imaginary line mentioned as forming the posterior boundary of the temporal lobe, posteriorly, by the cerebral cortex, and inferiorly by the lower part of the hemisphere. This lobe is small, irregular, and is formed by three convolutions, the superior occipital convolution, the middle occipital convolution, and the inferior occipital convolution. The internal hemispherical aspect presents the cuneiform lobule and the fissure of the hippocampus. This, in brief, is a summary of the lobes, convolutions, fissures and lobules of the cerebral hemispheres. In each of the regions thus designated, certain organs are localized, and when subjected to certain states of activity, the various mental phenomena of which the mind is susceptible are evolved.

In addition to this analysis of the action of the mind, it is not to be overlooked that there exists an auxiliary nervous apparatus known as the *Organic or Sympathetic System* of nerves, which communicate generally with the other part of the nervous system known as the cerebro-spinal axis. The Sympathetic system of nerves supplies the organs of the great splanchnic cavities, such as the heart, lungs, stomach, liver, etc., and, anastomosing freely with the nervous branches

springing from the spinal marrow and the brain, influences, in health and in disease, the functions of the brain. Morbid changes that occur in the blood and the *Reflex Action* of some portions of the nervous system must, also, be recognized.

The improved anatomy of the brain and the possibility of assigning to particular parts of the cerebro-spinal system certain functions with invariable exactness have recently directed the attention of physiologists more closely to the study of the cerebral cortex. The results of the experiments of Fritsch, Hitzic and Ferrier are prominent in reference to the localization of certain motor centres among the substance of the gray matter of the convolutions. These experiments seem to controvert the principle so long maintained that the gray ganglionic substance of the brain is not excitable by the electric current, or any other stimulus. Although the doctrine of placing motor centres in the convolutions is not universally accepted, it seems as likely for motor and sensory influence to be located in the substance of the gray matter of the cortex as among the gray matter of the *corpus striatum*, a fact which is not doubted at the present time. It may be, that extremely delicate medullary fibres from some points of the *corona radians* may be prolonged into the substance of the cortex. Be this as it may, there is undeniable evidence that the encephalon presides over and functionates the phenomena of intellectual and affective ideation. The accumulation of facts sufficiently prove this theory. In man, the moral and most noble qualities, the ability to compare impressions, to express remembrance, become enfeebled or entirely disappear when grave lesions of the encephalon occur. The simple compression of this organ produces a state of torpor or of coma which ceases

with the removal of the compression; the development of intelligence and of the moral aptitudes and perceptions follow, step by step, the evolution of infancy and the perfectioning of the encephalic mass: a malformation of this mass is the invariable antecedent cause of imbecility or idiocy. As all mental phenomena are comprised in the intellectual, the affective or instinctive faculties, the difficulty of assigning, in the present state of science, the exact confines of each cerebral organ, does not controvert or invalidate the general principle of cerebral localization, or disturb the proposition that there is always present a mutual and reciprocal relation between the existence of material organs with the performance of mental functions. It is well known and established that the functions of sensation and motion are definitely placed in certain fixed localities of the medulla spinalis and brain, that the vital actions necessary for the completion of respiration, of circulation, of digestion and other important functions have their functional origin in and about the medulla oblongata—that the origin of the nerves of special sense have their definite site in the part of the brain assigned to them, that the pons varolii, the tubercula quadrigemina, the optic thalami, and the corpora striata have their individual functions allotted to them, and that among the convolutions of the brain the function of the ideation and the exercise of articulate language is distinctly placed in the third frontal convolution of the left hemisphere. The principal once established, that the brain is a multiple organ composed of many organs and that the site of an organ and its function can be localized and separated from the others in the general structure of the encephalon, is sufficient to authorize the assertion, by induction, that each mental function must, also, be

associated with its especial organ. Upon this correlation of organ and function, a system of mental philosophy may be formed, resting upon a more solid basis and of more easy comprehension than the systems of metaphysics founded by reasoning emanating from the action of the mind itself, reflecting upon itself, in order to arrive at conclusions. This view of the constitution of the mind will lead to a more correct understanding of the subject of insanity.

The healthy condition of the organs and the harmony of action existing between organ and function will indicate a healthy condition of mind—the *mens sana*. The disturbance of this harmony of action, occurring from a morbid condition of the organs, will result in disease and disturbance of the mental functions, whence insanity arises—the *non compos mentis* of jurists.

It is not necessary, at present, to claim for the doctrine of localization the precise limitation of the cerebral organs. What is claimed for the principle is, that the brain, as a whole, is the organ of the phenomena of mind, that it is composed of an aggregation of organs, and that the organs are the functionating sources of the individual mental functions. It remains for the future to develop the system, as has been done in other organs, by physiological and pathological research, as, for example, the localization of the organ and function of articulate language in the convolution of Broca.

From observation and from comparative and pathological anatomy, certain mental faculties, under different terms, have been allotted to certain regions of the encephalon. To the frontal lobes have been assigned the organs of the intellectual faculties; to the posterior or occipital region, the affect-

ive or emotional organs; to the *temporo-sphenoidal* regions, the animal propensities, while the moral sentiments are stated to have their organs developed on the coronal region of the brain. These assignments of place, whether altogether correct or otherwise, will serve as a basis for the farther confirmation of the doctrine of cerebral localization.

As regards the proposed definition of Insanity, it is necessary to admit the doctrine as established, that the Brain is the organ of the mind; that it is a complex machine composed of many parts through the instrumentality or functioning influence, of which all mental phenomena are manifested. With this view of the functions of the brain and of the localization of the organs, it must also be understood, that though all the organs of the brain may be diseased at once, yet that it is quite possible for some organs to be in a diseased or abnormal condition, while others, at the same time, are perfectly healthy. The influence of the Organic system of nerves distributed to the organs of the great splanchnic cavities, and the sympathies exercised through them upon the Encephalon, have to be considered, in studying the direct and indirect etiological sources of Insanity.

As Ideation or the operations of the Brain are accomplished at the expense of changes—of partial or total disintegration taking place in the cells of the gray matter—it can be understood that particular organs may suffer if their functions are overtaxed beyond the physiological limit of waste and repair. If this pre-established harmony of relative metamorphosis, continually progressing in health, become temporarily disturbed, modifications of cerebral change must occur, accompanied by signs of mental exhaustion or dis-

turbance; if prolonged for a length of time abnormal mental manifestations will appear, representing different forms of insanity, according to the degree or intensity of the progressive change and the character and number of the implicated organs.

From the premises just given, a correct definition of Insanity would be, a morbid condition of a part or of the whole brain, as manifested by correct reasoning from false premises; by incorrect reasoning from correct premises; and by incorrect reasoning from false premises, according to the kind of insanity.

In the first case, the false premises originate in one part of the brain which is diseased while the other part, the reasoning part, is sound and acting correctly. In the second case, the premises originate in a healthy part of the brain, while the reasoning organs are morbidly affected. In the third case, the part of the brain in which the premises originate and also the reasoning part, are both morbidly affected or diseased.

This definition is not hypothetical: it is founded upon the character and constitution of the normal mind and from observation and study of the Insane, while living, followed up by future necroscopic examination. Resting upon Organized Structure for its derivation, it will lead to more correct methods of reasoning when mental Alienation, in its diversified modifications and phases, becomes the subject of discussion or of judicial investigation.

The arguments and statements here advanced concerning evolution, and the dependence of mind upon matter, to prove and establish a scientific proposition, are in no way corroborative of Deism or Atheism. The Creator chooses His

own way of maintaining correlation between man and Himself, and has planted in the human brain a set of organs which obliges us to acknowledge the great *First Cause* "who hath produced and will receive the soul."

The following cases of cerebral disease typically illustrate the perversion of function in co-relation with the locality of the lesion. In three of the cases given in detail, a limited portion of the brain was changed in structure, while the cortex of the convolutions remained sound and functionated in a normal manner ; the fourth case is an example of the morbid condition of the encephalon, mainly of the cortex, followed by acute mania in which all the psychical functions were abnormally manifested :

CASE 1.—The history of which dates back, during its progress as far as twenty years, commenced with cerebral sanguineous effusion accompanied by an apoplectic seizure, and terminated by abdominal dropsy and cirrhosis of the liver. The autopsy confirmed in a very positive manner the connection that existed between the cerebral lesions and the symptoms following the several attacks, taking place at short intervals, at the beginning of the disease. The injury found to have been inflicted upon the deep-seated portions of the cerebrum in proximity to and in the structure of the basal ganglions indicated severe shock at the time of seizure.

The patient, **A—F**, merchant, æt. 50, originally of good constitution, of superior intelligence, sanguineo-nervous temperament, and of exceedingly sensitive

disposition, after a prolonged period of bad health, the principal feature of which was a hemiplegic condition of the right side, called me in consultation for the first time, about two years previous to his decease. The history of the case up to that time was related to me by a member of his family, as follows: On August 1, 1862, at the age of thirty-two, while laboring under great mental depression and agitation, and under the strain of anticipated commercial disaster, he was suddenly seized about mid-day with an apoplectic attack, and was discovered in his library lying prostrate upon a sofa, completely insensible, breathing stertorously, and showing the other signs of cerebral sanguineous effusion. A physician was hurriedly called. The patient was carried up one flight of stairs to bed, and received proper medical attention. In twenty-four hours he showed signs of improvement, and by the following Sunday had so far recuperated as to sit up in bed and read the morning papers. During the night (about 2 a. m.) he was again taken very ill, losing his speech and the power of locomotion. In about a week after this attack he regained in a great degree his speech, and began slowly to recover somewhat the power of walking. In September, under advice, he went to the country, and continued to improve, gaining strength. This favorable turn in his condition was but of short duration; for in February, some five months after the second attack, he experienced another severe paralytic stroke, falling suddenly, while at the breakfast table, to the floor, insensible, speechless, and unable to move, with other symptoms so grave that his family supposed he was dying. He continued without much change in this helpless condition for about two weeks. He then commenced to show signs of returning intelligence, and

after a time regained very slight locomotive power. His right side remained paralytic, the right arm useless, and in efforts to walk, the right leg was put in motion mainly by being dragged. He was never able to assist in dressing himself after the last attack, and alluded to the paralytic side as his "dead side." Speech remained thick and indistinct.

The above statement contains the main features of this patient's history from the inception of his malady up to the time—a period of about eighteen years—when I was first called to see him. Notwithstanding the prolonged duration of the hemiplegia, the anterior part of the brain, after the immediate rude effects of the effusion had subsided, continued to act normally, and although otherwise helpless in a great degree, he directed his private affairs and household arrangements with discretion and good judgment.

The muscles of the face supplied by the *portio dura*, and of the orbit by the third pair or *motores oculorum*, showed no signs of morbid action. The organs of special sense manifested no impairment of function until the last year of his illness, when vision became defective, indicating extension of the cerebral lesion, and articulation was so difficult as to render speech barely intelligible. At this period the *left* side became affected by loss of sensation.

After the acute symptoms of the attack alluded to had subsided the patient fell into a passive state, hemiplegia of the right side being confirmed, and medical treatment of little use. He was well nursed, received every hygienic attention, and his general health was good. He was in the habit of spending the summers at his country-seat to avoid the heat of the city, returning to town at the beginning of winter. In the autumn of 1880 he became worse, and I was

then requested to visit him. At this time, the hemiplegia was very complete, the right leg dragging helplessly in any attempt at locomotion, and the right arm hanging lifelessly by the side, with some contraction of the wrist and fingers. Sensation, also, on this side was much impaired. Under the influence of tonics—quinine, nux vomica, phosphorus, etc.—administered in small doses, slight improvement took place. He continued to be interested in daily affairs, read the newspapers, and supervised some building operations. About twelve months prior to his death general sensibility on both sides became still more diminished, and on the *left* side to the extent of losing almost entirely the sensation of touch. Vision, also, became so impaired as to prevent his reading the daily papers, which, being one of the few pastimes still left to him, caused him to become greatly disheartened and despondent. A slight improvement afterward took place in the eyesight, and also in the tactile perceptions of the *left* side, but neither was restored to its condition prior to the relapse. In the early part of 1882 a sharp attack of jaundice came on, with tenderness over the hepatic region. This was followed by induration of the liver, œdema of the limbs, and abdominal dropsy, which required the operation of paracentesis to relieve the distress resulting from distension and difficulty of respiration. The patient continued to grow weaker, and gradually sank under the various complications from which he had suffered, dying in August of the same year, about twenty years after the first paralytic stroke.

The immediate cause of death in this case was cirrhosis of the liver and its sequent abdominal dropsy. The diagnosis I had given during life attributed the primary disease—the apoplectic seizures, accompanied by hemiplegia, and

subsequently complicated with partial anesthesia—to sanguineous effusion in the region of the corpus striatum of the left side, followed by softening of the structure of the corpus striatum, this invading the *internal capsule*, and extending to parts of the optic thalamus of the same side.

The loss of sensation and the diminution of motor power on the *left* side and the defect of vision can be accounted for by the diseased condition of the lenticular portion of the corpus striatum, of part of the optic thalamus of the *right* side, and of the posterior portion of the internal capsule, occurring during the progress of the malady, and which the autopsy revealed.

AUTOPSY.—The brain was placed on a marble slab, the base downward. With a fine cerebrum knife the left hemisphere was cut horizontally so as to expose the *centrum orale* of Vieussens; another section, about four millimetres deeper on the hemisphere, was then made in the same direction, immediately over the roof of the lateral ventricle. The lateral ventricle was now laid open by inserting the handle of a scalpel along the internal margin and breaking down the roof of the ventricle as far as the interior and posterior cornua, and pushing externally to one side the white substance overlying the ventricle. The upper surface of the corpus striatum, the optic thalamus, the choroid plexus, velum interpositum, and other parts of the ventricle were thus exposed. The two last-mentioned structures being removed, the upper surfaces of the corpus striatum and of the optic thalamus were fully brought into view, and presented the smooth, normal appearance common to the lining membrane of the ventricle. A section was next made by passing the knife vertically and transversely across the frontal lobe

immediately in front of the anterior extremity of the *corpus striatum*. This section was joined by another carried longitudinally and vertically backward near and parallel to the great *median fissure*, thus detaching a somewhat triangular portion of the frontal lobe, and exposing the structure of the anterior extremity of the corpus striatum and of the indentations in front of the convolutions of the *island of Reil*. On the surface thus presented nothing abnormal was seen. Another transverse section, parallel to the previous one, and about five millimetres posterior to it, was made through the corpus striatum and the other tissues immediately below it. The face of this section showed the fibres of the *internal capsule* located between the gray substance of the caudate and lenticular ganglions to be in a diseased condition. The lenticular portion presented a small cavity surrounded by yellow, softened structure encroaching upon the medullary fibres of the internal capsule. A third section was now made, about three millimetres behind the second, parallel to it, and a little in front of the line of depression that exists between the corpus striatum and the optic thalamus. This section opened up the middle part of the corpus striatum, in which was found a cavity, when held apart, large enough to contain a small bean, and the walls of which, to the extent of several millimetres, were surrounded by a pultaceous creamy substance which here invaded and destroyed the fibres of the *internal capsule*. The internal surface of this cavity was in part rough, congested, and of dark purple color. It extended a short distance into the anterior and external side of the optic thalamus, and was there also surrounded for a space of some millimetres by softened cerebral substance. A fourth transverse and verti-

cal section was made, through the *anterior* third of the optic thalamus. This showed the termination of the cavity and softened substance mentioned as existing in the corpus striatum and extending into the antero-lateral part of the optic thalamus. A fifth transverse and vertical section continued the examination across and through the *posterior* third of the optic thalamus, exposing a cavity large enough to contain a garden pea. This centre of hemorrhagic effusion was found also surrounded by softened structure. A transverse and a vertical section made on a level with the margin of the anterior tubercles (the nates) of the tubercula quadrigemina showed nothing abnormal. A transverse section made to drop vertically, as if through the parieto-occipital lobes, exposed a cavity in the white cerebral substance, nearly on a level with the centrum ovale, large enough to contain an ordinary-sized fibert. The wall of this cavity was directed toward the cuneiform lobe, and extended superiorly in the direction of the convolutions of the quadrilateral lobe. The white structure around this cavity was soft and pultaceous to the extent of several millimetres. The remaining parts of the left cerebral hemisphere presented no deviations from the normal condition.

The *right* cerebral hemisphere was now examined by first making the ordinary transverse section of the hemisphere to expose the white substance of the centrum ovale of Vieussens. A similar section, carried some lines deeper, opened a cavity, situated about the centre of the white substance of the cerebrum, of sufficient extent to contain a large-sized hazel-nut. This cavity was somewhat triangular in shape, extended laterally and internally toward the outer side of the optic thalamus and of the corpus striatum, and externally

about three centimetres and a half from the ascending parietal lobe. The perimeter of the cavity was surrounded by softened cerebral structure, invading inwardly the external wall of the lateral ventricle, the lenticular portion of the corpus striatum *external to the internal capsule*, and, to a limited extent, the posterior part of the *internal capsule*. The caudate ganglion and the anterior portions of the internal capsule were found to be unchanged. The remaining parts of the white medullary substance of the right and left hemispheres presented nothing abnormal. The *gray cortical substance* overlying the lobes and lobules of both hemispheres was in a perfectly healthy condition, as were also the dura mater, pia mater, and arachnoid membranes. The anfractuositie^s or *sulci* between the convolutions were of unusual depth, particularly in the fronto-parietal regions.

Upon a careful examination of the external and internal structure of the cerebellum, no change from the normal organization was perceptible.

The localization of the cerebral structures at fault in this case was diagnosticated, during life. The loss of motion on the right side was characteristic of disease of the *corpus striatum*, including part of the *internal capsule* of the left hemisphere. The anaesthesia, diminished motor power on the left side and imperfection of vision appearing, during the progress of the disease, represented the extension of the cerebral softening (*ramollissement*) of the external part of the *corpus striatum* of the right hemisphere and of the optic thalami. The cavity and softening found around it in the posterior part of the left hemisphere in proximity to the *gyrus angularis* may have modified somewhat the function of vision,

The defective articulation resulted from the *Wallerian degeneration*, met with in the medullary strands, passing backward and downward from the basal ganglions through the *medulla oblongata*, interfering with the origin and function of the hypoglossal nerve.

CASE 2.—Is noticeable from the definite localization of the disorganization of cerebral structure and the equally limited perversion of function. Experiments by vivisection, and more particularly pathological observations, attest the intimate connection of the *tubercula quadrigemina* with the rest of the nervous apparatus of vision.—A male patient, aged thirty-five years, of spare habit and in feeble health, was admitted to the ophthalmic department of the State Immigrants' Hospital, for amaurosis. He was entirely blind in both eyes, not being able to distinguish light from darkness in open day. His face presented a vacant stare, the pupils dilated and irresponsive to light, and the globes of the eyes apparently immovable. He walked with the unsteady gait of the blind, and had somewhat lost the power of locomotion. The internal humors of the eyes were translucent; the retinae appeared pale, anemic, and somewhat puckered.

This patient contracted a typhoid fever, to which he succumbed three weeks after the attack, and thus afforded an opportunity for a *post-mortem* examination. The brain, with the exception of being somewhat paler than natural, presented nothing specially abnormal until reaching the region of the *tubercula quadrigemina*. A bundle of hydatids, two of them as large as good-sized peas, with several others of smaller proportions, was to be seen directly over and implanted upon these organs. The *tubercula quadrigemina* were slightly atrophied, and the process of *ramollissement* had

begun. The optic tracts, chiasma, and optic nerves were abnormally white, shrunken, and cord-like, and the retinæ paler than natural, and somewhat atrophied. The diagnosis had decided the amaurosis to have originated from cerebral disturbance, and suitable treatment had been observed, without any beneficial result.

CASE 3.—Another case of similar import to that just related is recorded by Jobert de Lamballe.

“Chez un malade, la vue baissa graduellement, les pupilles se dilatèrent, et il n'y eut plus perception que d'une faible lueur. C'est par l'œil droit que la perte de la vue commença, et bientôt l'œil gauche cessa de voir à son tour. L'autopsie fit découvrir une tumeur comprimant les tubercules quadrijumeaux : mais la paire gauche avait plus souffert de la compression que la droite ; aussi l'atrophie était-elle plus marquée chez la première.”

The previous cases, in which the internal cerebral structure was found to be deceased, manifesting corresponding special functional disorder, while the cortex of the convolutions continued to perform its functions normally, are in contrast with the following case in which the cortex was found at fault, accompanied by symptoms of acute mania, while the functions of motion and of general and special sensation were not lost.

CASE 4.—I was lately called in consultation to see a gentleman, about forty years of age, originally of good constitution, a free liver, addicted, at times, to immoderate use of alcoholic liquors. At my visit, he was laboring under the symptoms of acute mania—flushed face, wild and vacant expression, restlessness, throwing himself upon a couch and getting suddenly up, walking rapidly to and fro, incoherent, full of

delusions and hallucinations, imagining the presence of hideous animals and of non-existing dangers to his person, muttering unintelligible sentences and utterly uncognizant of his condition and of the entreaties of his attendants. The pulse was rapid, great thirst, refusing food, at times inclined to be violent.

These symptoms continued unabated for a period of two days, when the patient, gradually becoming weaker, finally ran into a comatose condition and died, laboring under the symptoms of cerebral effusion.

Autopsy.—Upon removal of the calvarium and opening the *dura mater*, a quantity of serous fluid escaped, exposing the upper surface of the encephalon. Both hemispheres presented a congested state, the veins running, tortuous over the convolutions, distended with dark colored blood. The arachnoid exhibited generally a thickened, opaline appearance. The *pia mater* was universally red, showing a vascular condition, as if injected by colored "size." This appearance was also manifested in the anfractuosities between the convolutions. The ventricles were full of yellow serum, and the vellum interpositum and choroid plexuses were turgid with blood.

A section of each hemisphere, exposing the white substance of the *centrum ovale* displayed an unusual number red dots of escaping blood, showing that the medullary substance of the brain had participated somewhat in the severity of the attack, but no other morbid changes were found in the internal substance of the brain.

In this case, the characteristic pathological changes of the encephalon were followed by manifestations of universal and overwhelming mental aberration, in the form of acute mania.

